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**PRELIMINARY REGULATORY EVALUATION,
INITIAL REGULATORY FLEXIBILITY DETERMINATION,
AND TRADE IMPACT ASSESSMENT**

FOR

NOTICE OF PROPOSED RULEMAKING:

**REVISION OF HYDRAULIC SYSTEMS
AIRWORTHINESS STANDARDS TO HARMONIZE WITH
EUROPEAN AIRWORTHINESS STANDARDS FOR
TRANSPORT CATEGORY AIRPLANES**

OFFICE OF AVIATION POLICY, PLANS, AND MANAGEMENT ANALYSIS
AIRCRAFT REGULATORY ANALYSIS BRANCH, APO-320

Arnold J. Hoffman

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Executive Summary

This Regulatory Evaluation examines the impacts of a proposal to amend the airworthiness standards for hydraulic systems of transport category airplanes. The proposed changes to section 25.1435 of the Federal Aviation Regulations (FAR) would harmonize hydraulic systems design and test requirements with standards proposed for the European Joint Aviation Requirements (JAR). The proposals were developed in cooperation with the European Joint Aviation Authorities and the U.S. and European aviation industries through the Aviation Rulemaking Advisory Committee. The proposed changes would: (1) add appropriate existing JAR standards to achieve harmonization; (2) move some of the existing regulatory text to an advisory circular; (3) consolidate or separate some subparagraphs for clarity; and (4) revise airplane static proof pressure test requirements to require a complete functional (dynamic) airplane test at a lower pressure.

Although several revisions would be made to FAR § 25.1435, only three of them would impose additional costs. Most of the changes codify current industry practice or conform FAR § 25.1435 to corresponding sections of the JAR without substantive effects. Manufacturers of part 25 small airplanes could experience additional costs of approximately \$50,000 per type certification. On the other hand, manufacturers of part 25 large airplanes could experience a cost differential ranging from a \$25,000 cost reduction to a \$200,000 cost increase. Cost savings from harmonization and potential safety enhancement would exceed any incremental cost increases.

The proposed rule would not have a significant economic impact on small entities. In addition, it would not constitute a barrier to international trade, including the export of American airplanes to foreign countries and the import of foreign airplanes into the United States. Instead, the proposed changes, by harmonizing with standards in the JAR, would lessen restraints on trade.

Regulatory Evaluation of NPRM: Revision of Hydraulic Systems Airworthiness
Standards to Harmonize with European Airworthiness Standards for Transport
Category Airplanes

I. Introduction

This Regulatory Evaluation examines the impacts of a proposal to amend the airworthiness standards for hydraulic systems of transport category airplanes. The proposed changes to section 25.1435 of the Federal Aviation Regulations (FAR) would harmonize hydraulic systems design and test requirements with standards proposed for the European Joint Aviation Requirements (JAR). The proposals were developed in cooperation with the European Joint Aviation Authorities (JAA) and the U.S. and European aviation industries through the Aviation Rulemaking Advisory Committee (ARAC). These changes would benefit the public interest by standardizing certain requirements, concepts, and procedures contained in the airworthiness standards without reducing, and potentially enhancing, the current level of safety.

The FAA proposes to: (1) add appropriate existing JAR standards to achieve harmonization; (2) move some of the existing regulatory text to an advisory circular (AC 25.1435-1); (3) consolidate or separate some subparagraphs for clarity; and (4) revise airplane static proof pressure test requirements, § 25.1435(b)(1), to require a complete functional (dynamic) airplane test at a lower pressure.

II. Background

The airworthiness standards for transport category airplanes are contained in part 25 of the FAR. These standards apply to airplanes manufactured within the U.S. and to airplanes manufactured in other countries and imported under a bilateral airworthiness agreement.

The JAA developed a common set of airworthiness standards for use within the European aviation community. The standards for European type certification of transport category airplanes, JAR-25, are based to a large extent on part 25 of the FAR. Type certificates issued under JAR-25 standards are accepted by the aircraft certification authorities of 23 European countries.

FAR part 25 and JAR-25 are, however, not identical. Certain differences between the standards can result in substantial additional certification costs when airplanes are type-certificated to both sets of standards. These additional costs do not necessarily bring about an increase in safety since the FAR may use different means than the JAR to accomplish the same safety intent.

Recognizing that a common set of standards would not only economically benefit the aviation industry but also maintain the necessary high level of safety, the FAA and JAA, in 1988, began a process to harmonize the airworthiness requirements of the U.S. and Europe. During the June 1992 FAA/JAA annual meeting in Toronto, Canada, the Aviation Rulemaking Advisory Committee (ARAC) was recognized as the forum through which rulemaking harmonization will be

achieved. The ARAC was formally established by the FAA on January 22, 1991 to provide advice and recommendations concerning the FAA's rulemaking program. The Hydraulic Systems Harmonization Working Group was formed and tasked to develop a draft Notice of Proposed Rulemaking (NPRM) and collateral documents relating to hydraulic systems of transport category airplanes. The JAA is developing similar proposals to amend JAR-25.

III. Proposed Changes and Associated Costs and Benefits

Although several revisions would be made to FAR § 25.1435, only three of them would impose additional costs (see below -- proposals 1, 4, and 12, with the latter having potential cost savings for some manufacturers). Most of the changes codify current industry practice or conform FAR § 25.1435 to corresponding sections of the JAR. Adoption of the proposed changes would increase harmonization and commonality between American and European airworthiness standards. Harmonization would eliminate unnecessary duplication of airworthiness requirements, thus reducing manufacturers' certification costs. One manufacturer of part 25 small airplanes estimated such cost-savings could range between \$30,000 and \$90,000 per type certification (pertaining to hydraulic systems only). Equivalent savings for part 25 large airplane type certifications would probably be several times these amounts. Potential safety enhancement resulting from specification of minimum accepted standards would supplement these benefits.

Proposal 1. Current § 25.1435(a)(1) would be replaced by the existing JAR 25.1435(a)(10) and associated Appendix K requirements regarding design

load factors for proof and ultimate pressure conditions for elements of the hydraulic system (see proposal 2 below with respect to contents of current § 25.1435 (a)(1)). The proposed load factors, ranging between 1.5 and 4.0, relate to the design operating pressure (DOP) and apply to tubes, fittings, elements containing gas connected to a pneumatic pressure source (e.g. hydraulic reservoirs), elements containing pressurized gas connected to hydraulic pressure source (e.g. accumulators), hoses, and other miscellaneous elements. By adopting the JAR minimum factors of safety standards which currently are not specifically stated in the FAR, the FAA intends to retain an existing level of safety because normal U.S. industry practices meet or exceed these standards. DOP is the normal maximum steady pressure. Excluded are reasonable tolerances and transient pressure effects. In localized-areas of systems and system elements, the DOP may be different from the DOP for the system as a whole due to the range of normally anticipated airplane operational, dynamic and environmental conditions. Such differences must be taken into account. The term "design operating pressure" would be discussed in AC 25.1435-1.

The proposed changes would not result in additional certification/production costs for most manufacturers. However, one manufacturer of part 25 small airplanes estimated increased testing costs of approximately \$25,000 per type certification. Codification of the proposed standards would ensure that current safety levels are retained.

Proposal 2. Current § 25.1435(a)(1) would be redesignated as § 25.1435(a)(2) with deletion of some extraneous words and other minor edits. The term "limit structural load" and a recommended minimum time to hold pressure would be discussed in AC 25.1435-1. There would be no additional costs associated with these minor changes.

Proposal 3. Current § 25.1435(a)(2) would be redesignated as new § 25.1435(a)(3) with deletion of some extraneous words and other minor edits. The term "ultimate structural load" and a minimum time to hold pressure would be discussed in AC 25.1435-1. There would be no additional costs associated with these minor changes.

Proposal 4. A new § 25.1435(a)(4) would be added, containing current § 25.1435(b)(2)(i) and (b)(2)(ii) requirements regarding induced loads, pressure transients, and fatigue, as well as the current JAR 25.1435(a)(11) requirements regarding fatigue design considerations accounting for fluctuating or repeated external or internal loads and pressure transients. These loads could be structurally or environmentally induced. By delineating these requirements, the FAA intends to ensure that each element is designed to provide fatigue resistance capability consistent with anticipated element usage, thus maintaining the current level of safety. The terms "fatigue," and "externally induced loads" would be discussed in AC 25.1435-1.

Although some of the changes described are new requirements in the FAR, most American manufacturers of large transport category airplanes are already in compliance with the similar current European standards, which had to be met in

order to market airplanes in JAA member countries. The modified testing and analysis regime is already in place. Initial "first time" costs have already been incurred and have diminished in recent certifications. Consequently, incremental costs incurred subsequent to harmonization would be negligible. One manufacturer, however, indicated that additional testing and analysis costs, ranging between \$100,000 and \$200,000 per type certification, would be incurred for the first one or two type certifications; learning curve efficiencies would likely reduce these costs thereafter. Manufacturers of part 25 small airplanes, on the other hand, expect no or negligible additional costs attributable to the new fatigue-related proposals.

Codification of the proposed standards would ensure that minimum acceptable fatigue requirements are specified with potential for safety enhancement.

Proposal 5. A new § 25.1435(a)(5) would be added, containing the current requirements of § 25.1435(b)(2)(i) through (b)(2)(v), except those addressed under proposal 4 above, as well as parts of the current JAR 25.1435(a)(5) and (a)(6) requirements to prevent excessive vibration, abrasion, corrosion, and mechanical damage, and to ensure the ability to withstand inertia loads. These requirements would be consolidated and simplified by stating that each element must be designed to perform as intended under all environmental conditions for which the airplane is certificated. An acceptable means of compliance would be included in AC 25.1435-1.

These changes codify existing industry standards for protection from physical/environmental degradation and resistance to inertia loads and would not result in additional certification/production costs. Codification of the proposed standards would ensure that current safety levels are retained.

Proposal 6. A modified version of current JAR 25.1435 (a)(2) would be added to the FAR as a revised § 25.1435 (b)(1), requiring means to indicate the appropriate system parameters at a flight crewmember station if (1) the system performs a function necessary for continued safe flight and landing, or (2) in the event of hydraulic system malfunction, corrective action by the crew is required to ensure continued safe flight and landing (see proposal 12 below with respect to status of current § 25.1435(b)(1) requirements). The existing JAR 25.1435(a)(2) requires fluid quantity and pressure indication under specified circumstances; prior to Amendment 25-72 in 1990, FAR § 25.1435 contained an identical requirement. It was considered at the time that this requirement is covered by FAR § 25.1309(c), which requires that warning information must be provided to alert the crew to unsafe system operating conditions and to enable it to take appropriate corrective action, and the § 25.1435 requirement was therefore deleted. It is now recognized, however, that there is value in defining indication requirements for hydraulic systems and implications of their loss. The term "appropriate system parameters" would be discussed in AC 25.1435-1.

These changes codify existing industry standards and would not result in additional certification/production costs. Codification of the proposed standards would ensure that current safety levels are retained.

Proposal 7. The current § 25.1435(b)(2) would be replaced by a modified version of the current JAR 25.1435(a)(4) and (a)(7) to require that each system have means to ensure that system pressures remain within the design capabilities of elements (see proposal 11 below with respect to contents of current § 25.1435(b)(2)). Prior to Amendment 25-72, § 25.1435 contained the identical JAR requirement, but it was characterized as containing arbitrary transient limits and being unnecessary because the intent is covered under § 25.1309 (Equipment, systems, and installations). The requirement was therefore deleted from § 25.1435. The proposed version deletes the arbitrary limits but requires that the intent be specifically addressed by § 25.1435(b)(2) to ensure consideration of the pressure and volume related transients that are unique to the hydraulic systems. An acceptable means of compliance with § 25.1435(b)(2) would be included in AC 25.1435-1.

There would be no additional costs associated with these changes since industry is currently meeting the same requirements under § 25.1309. Clarification of standards for pressure/volume transients under § 25.1435 would ensure that current safety levels are retained.

Proposal 8. A new § 25.1435(b)(3) would be added with new requirements for minimizing harmful or hazardous concentrations of hydraulic fluid or vapors, if liberated in any form, into the crew or passenger compartments during flight. These proposed standards would be similar to those in existing JAR 25.1435(a)(5). Prior to amendment 25-72, § 25.1435 contained an identical requirement. The amendment removed the requirements since it was assumed that similar air standards were imposed by § 25.831(b) in the general statement

that the ventilation air must be free of hazardous or harmful gases or vapors. However, § 25.831(b) specifies allowable limits for carbon monoxide and carbon dioxide, but no other products. It could be construed that those two gases are the only hazardous products. Section 25.1435 is therefore proposed to be revised to state the requirement with respect to hydraulic fluid or vapors generally. An acceptable means of compliance with § 25.1435(b)(3) and a discussion of the terms "harmful" and "hazardous" would be included in AC 25.1435-1.

Since the proposed changes codify existing industry standards, there would be no additional certification/production costs. Codification of the proposed standards would ensure that current safety levels are retained.

Proposal 9. Current § 25.1435(c) would be redesignated as new § 25.1435(b)(4), which is identical to existing JAR 25.1435(c) requirements regarding use of flammable hydraulic fluid and fire protection. A discussion of the term "flammable hydraulic fluid" would be included in AC 25.1435-1. There would be no additional costs associated with this redesignation.

Proposal 10. A new § 25.1435(b)(5) would be added that would require manufacturers to specify the approved hydraulic fluid(s) suitable to be used in the system(s) and ensure that the system(s) meet the applicable placarding requirements of current § 25.1541. These requirements are the same as those in existing JAR 25.1435(d). Although it is standard industry practice to identify the compatible hydraulic fluid on each component's nameplate, the practice may not be universal. In order to minimize the potential use of

incompatible fluids, seals, etc. in any system, it is necessary to include these requirements. A discussion of mixability of hydraulic fluids from different suppliers would be included in AC 25.1435-1.

Since these changes codify existing industry standards, there would be no additional certification/production costs. Codification of the proposed standards would ensure that current safety levels are retained.

Proposal 11. Current § 25.1435(b)(2) requirements for hydraulic system compliance by test and analysis would be separated into §§ 25.1435(c), (c)(1) and (c)(2); the list of environmental factors (current § 25.1435(b)(2)(ii) through (b)(2)(v)) would be moved to AC 25.1435 and the text in these sections would be clarified. In addition, analysis may be used in place of or to supplement testing, where shown to be reliable and appropriate. A discussion on the number of endurance and fatigue cycles, guidance on conducting fatigue testing, and simulated failures would be included in AC 25.1435-1.

There would be no additional costs associated with these revisions. The use of analysis in place of or supplemental to testing may reduce certification costs in some cases.

Proposal 12. Current § 25.1435(b)(1) requirements for static testing of a complete hydraulic system to 1.5 times the design operating pressure (without deformation that would prevent performance of intended function) would be replaced with a new § 25.1435(c)(3) requirement that "the complete hydraulic system must be functionally tested on the airplane over the range of

motion of all associated user systems." "The test must be conducted at the system relief pressure or 1.25 times the DOP if a system pressure relief device is not part of the system design." This proposal reflects the recently granted petition for exemption to the Boeing Company, FAA Regulatory Docket No. 27384. A discussion on relief pressure settings and an acceptable means of compliance with § 25.1435(c)(3) would be included in AC 25.1435-1.

The FAA considers that the proposed functional (i.e., dynamic) test more closely approximates actual operating conditions than the existing static test. For the static test, several parts of the system and associated relief valves (including return lines) may require disabling to allow system pressurization at 1.5 times the design operating pressure because the relief valves are designed to open at pressures lower than 1.5 times the design operating pressure. Although the proposed test pressure would be lower than 1.5 times the design operating pressure, all elements must still be able to withstand at least 1.5 times the design operating pressure per current § 25.1435(a)(2) (proposed § 25.1435(a)(3)).

Most manufacturers of part 25 airplanes would not experience any increased costs associated with dynamic testing of hydraulic systems. In fact, since unlike static testing, the proposed dynamic testing does not entail disabling any system(s) or otherwise reconfiguring the airplane, testing time and associated costs could be reduced to some small extent. One manufacturer of part 25 large airplanes estimates potential savings of approximately \$25,000 per type certification in this regard. However, a manufacturer of part 25

small airplanes estimates \$25,000 in additional testing, analysis, and report preparation costs per type certification attributable to this proposal.

The proposed requirements at least retain, and potentially enhance, the current level of safety by identification of additional dynamic interference problems.

IV. Summary of Costs and Benefits

Manufacturers of part 25 small airplanes could experience additional costs totalling approximately \$50,000 per type certification resulting from proposals 1 (design load factors) and 12 (system clearance check). For manufacturers of part 25 large airplanes, the cost differential could range from a \$25,000 cost reduction (for one manufacturer, resulting from proposal 12) to a \$100,000 - \$200,000 cost increase (for another manufacturer, resulting from proposal 4). The cost savings from harmonization would easily exceed these relatively low additional costs. Potential safety enhancement resulting from specification of minimum accepted standards would supplement these benefits. Consequently, the FAA finds the proposed rule to be cost-beneficial.

V. Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires a Regulatory Flexibility Analysis if

a proposed or final rule would have a significant economic impact, either detrimental or beneficial, on a substantial number of small entities. FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, prescribes standards for complying with RFA review requirements in FAA rulemaking actions. The Order defines "small entities" in terms of size thresholds, "significant economic impact" in terms of annualized cost threshold, and "substantial number" as a number which is not less than eleven and which is more than one-third of the small entities subject to the proposed or final rule.

The proposed rule would affect manufacturers of transport category airplanes produced under future new airplane type certifications. For manufacturers, Order 2100.14A specifies a size threshold for classification as a small entity as 75 or fewer employees. Since no part 25 airplane manufacturer has 75 or fewer employees, the proposed rule would not have a significant economic impact on a substantial number of small manufacturers.

VI. International Trade Impact Assessment

The proposed rule would not constitute a barrier to international trade, including the export of American airplanes to foreign countries and the import of foreign airplanes into the United States. Instead, the proposed changes would harmonize with corresponding existing or proposed standards in the JAR, thereby lessening restraints on trade.

For Insertion Into Preamble of NPRM:

"Revision of Hydraulic Systems Airworthiness Standards to Harmonize with European Airworthiness Standards for Transport Category Airplanes"

Regulatory Evaluation, Regulatory Flexibility Determination, and Trade Impact Assessment

Changes to federal regulations must undergo several economic analyses. First, Executive Order 12866 directs Federal agencies to promulgate new regulations or modify existing regulations only if the potential benefits to society outweigh the potential costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Finally, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these assessments, the FAA has determined that this proposed rule: 1) would generate benefits exceeding its costs and is not "significant" as defined in Executive Order 12866; 2) is not "significant" as defined in DOT's Policies and Procedures; 3) would not have a significant impact on a substantial number of small entities; and 4) would lessen restraints on international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

Costs and Benefits

Manufacturers of part 25 small airplanes could experience additional costs totalling approximately \$50,000 per type certification resulting from proposals 1 (design load factors) and 12 (system clearance check). For manufacturers of part 25 large airplanes, the cost differential could range from a \$25,000 cost reduction (for one manufacturer, resulting from proposal 12) to a \$100,000 - \$200,000 cost increase (for another manufacturer, resulting from proposal 4).

The proposed changes would increase harmonization and commonality between American and European airworthiness standards, thereby eliminating unnecessary duplication of airworthiness requirements and reducing manufacturers' certification costs. One manufacturer of part 25 small airplanes estimated such cost-savings could range between \$30,000 and \$90,000 per type certification (pertaining to hydraulic systems only). Corresponding savings for part 25 large airplane type certifications would be several times these amounts. The cost savings from harmonization would easily exceed the relatively low incremental costs of the rule. Potential safety enhancement resulting from specification of minimum accepted standards would supplement these benefits. Consequently, the FAA finds the proposed rule to be cost-beneficial.

Proposal 1. These changes codify existing industry standards. As such, they would not result in additional costs for most manufacturers. However, one manufacturer of part 25 small airplanes estimated increased testing costs of approximately \$25,000 per type certification. Codification of the proposed standards would ensure that current safety levels are retained.

Proposals 2, 3, and 9. There would be no additional costs associated with these minor changes.

Proposal 4. Although some of the changes described are new requirements in the FAR, most American manufacturers of large transport category airplanes are already in compliance with the similar current European standards, which had to be met in order to market airplanes in JAA member countries. The modified testing and analysis regime is already in place. Initial first-time costs have already been incurred; such costs have diminished in recent certifications. Consequently, actual incremental costs would be negligible. One manufacturer, however, indicated that additional testing and analysis costs, ranging between \$100,000 and \$200,000 per type certification, would be incurred for the first one or two type certifications. Learning curve efficiencies would likely reduce these costs thereafter. Manufacturers of part 25 small airplanes, on the other hand, expect no or negligible additional costs attributable to the new fatigue-related proposals. Codification of the proposed standards would ensure that minimum acceptable fatigue requirements are specified with potential for safety enhancement.

Proposals 5, 6, 7, 8, and 10. These changes codify existing industry standards and would not result in additional certification/production costs. Codification of the proposed standards would ensure that current safety levels are retained.

Proposal 11. There would be no additional costs associated with these revisions. The use of analysis in lieu of or supplemental to testing may reduce certification costs in some cases.

Proposal 12. Most manufacturers of part 25 airplanes would not experience additional costs associated with dynamic testing of hydraulic systems. In fact, testing time and associated costs could be reduced to some small extent since, unlike static testing, the proposed dynamic testing would not entail disabling any system(s) or otherwise reconfiguring the airplane. One manufacturer of part 25 large airplanes estimates potential savings of approximately \$25,000 per type certification in this regard. However, a manufacturer of part 25 small airplanes estimates \$25,000 in additional testing, analysis, and report preparation costs per type certification attributable to this proposal. The proposed requirements would at least retain, and potentially enhance, the current level of safety by identification of additional dynamic interference problems.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by

government regulations. The RFA requires a Regulatory Flexibility Analysis if a proposed or final rule would have a significant economic impact, either detrimental or beneficial, on a substantial number of small entities. FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, prescribes standards for complying with RFA review requirements in FAA rulemaking actions. The Order defines "small entities" in terms of size thresholds, "significant economic impact" in terms of annualized cost threshold, and "substantial number" as a number which is not less than eleven and which is more than one-third of the small entities subject to the proposed or final rule.

The proposed rule would affect manufacturers of transport category airplanes produced under future new airplane type certifications. For manufacturers, Order 2100.14A specifies a size threshold for classification as a small entity as 75 or fewer employees. Since no part 25 airplane manufacturer has 75 or fewer employees, the proposed rule would not have a significant economic impact on a substantial number of small manufacturers.

International Trade Impact Assessment

The proposed rule would not constitute a barrier to international trade, including the export of American airplanes to foreign countries and the import of foreign airplanes into the United States. Instead, the proposed changes to the FAR would harmonize with corresponding existing or proposed standards in the JAR, thereby lessening restraints on trade.